Synopsis of Self-Etching Adhesives (Project 04-40) (2/05)

Click here for tables of currently available self-etching adhesives

---

Adhesives or bonding agents have changed dramatically in the last couple of years. Manufacturers have developed new adhesives that are easier and faster to place. However, simplification does not guarantee equal or improved effectiveness. Current resin-based adhesives may be divided into two major categories based on the number of clinical steps and their interaction with the tooth surface. The two categories are “etch & rinse” and “self-etch”.[1]

“Etch & rinse” adhesives (also known as "total etch") have been around since the early 1990’s. These adhesives require three steps that use an acidic conditioner, primer and bonding resin. In order to reduce the placement time and complexity of these multi-step adhesives, manufacturers combined the primer and resin components to create a two-step system. Advantages of the etch & rinse adhesives are a good predictable enamel etch and the availability of favorable long-term clinical studies.[1,2] However, the etch & rinse systems are sensitive to the level of dentin wetness after rinsing off the acidic conditioner. Too little or too much remaining water may lead to reduced adhesion.[3]

“Self-etch” adhesives have only recently been introduced and are divided into one- and two-step systems. Two-step self-etching adhesives combine the acidic conditioner with the primer in the initial step and use a bonding resin in the second step. Even further reduction in the number of steps came with the introduction of one-step self-etching adhesives that combine the conditioner, primer, and adhesive. One advantage to these new adhesives is that the conditioner need not be rinsed off. The clinician does not need to be concerned about the level of dentin wetness. These self-etching systems may also potentially reduce post-operative sensitivity by providing simultaneous infiltration of the adhesive to the depth of demineralization and dissolving the smear layer without exposing dentinal tubules. However, in general, laboratory tests have shown a reduction in bond strengths and only limited clinical data is available.[1] Also, many of the newer self-etching adhesives have limited clinical applications and are primarily indicated for direct bonding of composite resins. Most self-etching adhesive systems are contraindicated for use on uncut enamel and many must be stored in the refrigerator.

Adhesive Categories
Etch & rinse - Three-step - conditioner, primer, adhesive - Two-step - conditioner, (primer & adhesive) Self-etch - Two-step - (conditioner & primer), adhesive - One-step - (conditioner & primer & adhesive)

Adverse acid-base reactions and adhesive permeability may contribute to the incompatibility between some adhesive systems and chemically- or dual-cured composite resins.[4-6] Chemically- or dual-cured composite resins may be used as core-buildups and bonding indirect restorations and endodontic posts. With three-step etch & rinse and two-step self-etch adhesives, a layer of neutral adhesive resin is always placed as a final increment prior to placement of a composite resin. However, the simplified adhesives (i.e., two-step etch & rinse, one-step self-etch) contain acidic monomers in the final step prior to composite resin placement. Consequently, uncured acidic monomers from the oxygen-inhibited layer of the cured adhesive are in direct contact with the resin composite. These acidic monomers can adversely react with the basic catalyst components of the chemically- or dual-cured composites. Different types of co-initiators may be included in an attempt to overcome the catalytic incompatibility. Simplified adhesives may also create a hypertonic environment that allows water to osmotically move from the dentinal surface through the permeable adhesive and create superficial water blisters that may disrupt the bonding between the adhesive and the overlying composite resin.[4-6] For best results, use the adhesive bonding agent recommended by the manufacturer of the chemical- or dual-cured composite resin material. Three-

step etch & rinse and two-step self-etch adhesive bonding agents are generally compatible.[7] Carefully follow the manufacturer's instructions if attempting to use two-step etch & rinse adhesives. Many one-step self-etch adhesives are contraindicated for use with chemically- or dual-curing composite resins (that are not light cured).

Another way to categorize adhesives is chronologically by generation. The three-step etch & rinse adhesives are considered fourth-generation adhesives. The fifth-generation consists of the two-step etch & rinse adhesives. The new self-etch products are considered the sixth generation and seventh generation. The sixth generation may be subdivided into Type 1 (i.e., two-step; acidified primer and adhesive applied separately) and Type 2 (i.e., one-step; self-etching adhesives are mixed and applied). The seventh generation adhesives require no mixing and are simply placed in one step.

In summary, there has been a trend toward simplified application with a reduced number of steps. However, faster is not always better. The continued use of the more traditional etch & rinse adhesives may be prudent due to favorable long-term clinical and laboratory data. The self-etch adhesives may be promising because of the reduced technique sensitivity and possible reduction in post-operative sensitivity. However, more controlled clinical studies are necessary to substantiate the marketing claims of reduced or eliminated post-operative sensitivity. Recent studies suggest no difference between self-etching and etch & rinse adhesives in reducing sensitivity.[8,9] Laboratory studies have shown an overall downward trend in bond strengths, especially with the one-step version.[1] The correlation between laboratory bond-strength studies and clinical success is unknown. However, at least one 1-step self-etching adhesive has been reported in a clinical study as having low retention of composite restorations in non-carious cervical lesions.[10] Caution is advised with new adhesive systems until controlled clinical studies are available.

To make it easier for clinicians to compare and contrast various features of self-etching adhesives, information was obtained from manufacturers and compiled into tables. When reviewing the tables, please keep in mind that the information may be incomplete or not provided (i.e., proprietary). While DIS attempted to contact all known manufacturers that market a self-etching adhesive system, some may have been inadvertently left off.

References

1. Van Meerbeek B, De Munck J, Yoshida Y, Inoue S, Vargus M, Vijay P, Van Landuyt K, Lambrechts P, Vanherle G. Adhesion to enamel and dentin: current status and future challenges. Oper Dent 2003;28:215-235.
2. Van Meerbeek B, Peumans M, Gladys S, Braem M, Lambrechts P, Vanherle G. Three-year clinical effectiveness of four total-etch dentinal adhesive systems in cervical lesions. Quintessence Int 1996;27:775-784.
3. Sano H, Takatsu T, Ciucchi B, Horner JA, Mathews WG, Pashley DH. Nanoleakage: leakage within the hybrid layer. Oper Dent 1995;20:18-25.
4. Tay FR, Pashley DH, Yiu CKY, Sanares AME, Wei SHY. Factors contributing to the incompatibility between simplified-step adhesives and chemically-cured or dual-cured composites. Part I. Single-step self-etching adhesive. J Adhes Dent 2003;5:27-40.
5. Tay FR, Suh Bim, Pashley DH, Prati C, Chuang S, Feng L. Factors contributing to the incompatibility between simplified-step adhesives and chemically-cured or dual-cured composites. Part II. Single-bottle, total-etch adhesive. J Adhes Dent 2003;5:91-105.
6. Suh BI, Feng L, Pashley DH, Tay FR. Factors contributing to the incompatibility between simplified-step adhesives and chemically-cured or dual-cured composites. Part III. Effect of acidic resin monomers. J Adhes Dent 2003;5:267-282.
7. Composite Core Materials, Dental Advisor 2004;2:1-4.4.
8. Perdigao J, Geraldeli S, Hodges JS. Total-etch versus self-etch adhesive: effect on postoperative sensitivity. J Am Dent Assoc 2003;134:1621-1629.
9. Perdigao J, Anauate-Netto C, Carmo AR, Hodges JS, Cordeiro HJ, Lewgoy HR, Dutra-Correa M, Castilhos N, Amore R. The effect of adhesive and flowable composite on postoperative sensitivity: 2-week results. Quintessence Int 2004;35:777-784.
10. Brackett WW, Covey DA, St Germain HA. One-year clinical performance of a self-etching adhesive in Class V resin composites cured by two methods. Oper Dent 2002;27:218-222.